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EXAMINER

HOGANS, DAVID L

ART UNIT PAPER NUMBER

2813

DATE MAILED: 06/19/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Applicati n No.

10/086,892

Applicant(s)

LEE, KYO-YEOL

Examiner

David L. Hogans

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 14 May 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-40 is/are pending in the application.
- 4a) Of the above claim(s) 8-14, 16-25, 31-33 and 36-40 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-7, 15, 26-30, 34 and 35 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 04 March 2002 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

### **DETAILED ACTION**

This Office Action is in response to the Election filed on July 23, 2002.

#### ***Status of Claims***

Claims 1-7, 15, 26-30 and 34-35 are pending. Claims 8-14, 16-25, 31-33 and 36-40 are withdrawn.

#### ***Election/Restrictions***

1. Applicant's election of Claims 1-7, 15, 26-30 and 34-35/Species I in Paper No. 8 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).
2. Claims 8-14, 16-25, 31-33 and 36-40 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected species, there being no allowable generic or linking claim. Election was made **without** traverse in Paper No. 8.

#### ***Claim Rejections - 35 USC § 102***

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1 and 3 are rejected under 35 U.S.C. 102(b) as being anticipated by 5,985,687 to Bowers et al.

In reference to Claims 1 and 3, Bowers et al. teaches:

- preparing a sapphire substrate (column 4 lines 7-20 and 55-60)
- forming a first buffer layer on the sapphire substrate (column 4 lines 7-20 and 55-60)
- forming a semiconductor layer on the first buffer layer (column 4 lines 7-20 and 55-60)
- removing the sapphire substrate (column 4 lines 7-20 and 55-60)

***Claim Rejections - 35 USC § 103***

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 2, 4-6, 26, 27 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over 5,985,687 to Bowers et al. in view of 5,290,393 to Nakamura.

Claim 2, 4, 26, 27 and 34

Incorporating all arguments of Claim 1 and noting that Bowers et al. fails to explicitly teach forming a second buffer layer on the semiconductor layer before removing the base substrate, wherein the second buffer layer has the same structure as the first buffer layer and wherein the semiconductor layer is a silicon doped GaN layer.

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However, Nakamura, in Figure 12 and columns 5-6 lines 60-02 and columns 8-12 lines 5-27, teaches forming a second buffer layer formed on a silicon doped GaN semiconductor layer and wherein the first and second buffer layer have the same structure (i.e. – each buffer layer is a 0.02 micrometer GaN layer formed under similar process conditions).

It would have been obvious to one of ordinary skill in the art to modify Bowers et al. by incorporating a first and second buffer layer comprised by the same structure, wherein the second buffer layer is formed on a silicon doped GaN semiconductor layer, as taught by Nakamura, to improve crystallinity, carrier concentration and mobility. (See Figures 9 and 10 and column 5 lines 14-20 and column 9 lines 4-25 and column 10 lines 50-65)

#### Claims 5 and 6

Incorporating all arguments of Claims 1 and 2 and noting that Bowers et al. fails to explicitly teach wherein the doping concentration profile of the second buffer layer is symmetrical or asymmetrical to the first buffer layer.

However, Nakamura, in column 8 lines 5-61 and column 10 lines 38-50, teaches wherein the first and second buffer layers have a symmetrical doping profile (i.e. – both undoped), and in column 8 lines 5-61 and column 10 lines 38-50 and column 11 lines

10-31, Nakamura teaches the first buffer layer being doped and the second buffer layer being undoped (i.e. – asymmetrical).

It would have been obvious to one of ordinary skill in the art to modify Bowers et al. by incorporating wherein the doping concentration profile of the second buffer layer is symmetrical or asymmetrical to the first buffer layer, as taught by Nakamura, to improve the crystallinity of the epitaxial GaN semiconductor layer (i.e. – grown on undoped) and to also improve the conductivity characteristics of the n or p type GaN semiconductor epitaxial layers grown on the doped buffer layers. (See column 5 lines 14-20 and column 12 lines 18-27)

Furthermore, the Examiner notes that the specification contains no disclosure of either the critical nature of the claimed method or any unexpected results arising therefrom (i.e. – what unexpected results arise from symmetry, or lack thereof, of buffer layers when forming semiconductor layers). Where patentability is said to be based upon particular chosen methods or upon other variables recited in a claim, the Applicant must show that the chosen methods are critical. *In re Woodruff*, 919 F.2d 1575, 1578 (Fed. Cir. 1990).

7. Claims 7, 15, 28-30 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over 5,985,687 to Bowers et al. in view of 5,290,393 to Nakamura in view of 5,927,995 to Chen et al.

Claims 7, 15, and 28-30

Incorporating all arguments of Claims 1 and 2 and noting that Bowers et al. and Nakamura fail to explicitly teach wherein the first and/or second buffer layer is formed of multiple semiconductor layers having different doping concentrations.

However, Chen et al., in columns 1-2 lines 65-33, teaches wherein the first and/or second buffer layers can be formed of multiple semiconductor layers (crystalline, crystalline with fewer dislocations and amorphous) having different doping concentrations (i.e. – nitrogen implantation). Furthermore, the first and second buffer layers can have a symmetrical doping profile (i.e. – a GaN epi layer grown between and joining two recrystallized buffer regions on two parallel sapphire substrates), or they can have a asymmetrical doping profile by successively forming a buffer/epi/buffer/epi layered structure, with the top layer of each buffer layer being recrystallized as suggested by Chen et al.

It would have been obvious to one of ordinary skill in the art to modify Bowers et al. and Nakamura by incorporating wherein the first and/or second buffer layers can be formed of multiple semiconductor layers (crystalline, crystalline with fewer dislocations and amorphous) having different doping concentrations (i.e. – nitrogen implantation), as taught by Chen et al., to generate GaN layers on sapphire having fewer dislocations (i.e. – a higher quality).

Claim 35

Incorporating all arguments of Claims 1, 2 and 15 and noting that Bowers et al. fails to explicitly teach wherein the semiconductor layer is a Group III-V compound having conductivity.

However, Nakamura, in column 6 lines 03-45, teaches a semiconductor layer that is a Group III-V compound having conductivity.

It would have been obvious to one of ordinary skill in the art to modify Bowers et al. by incorporating a semiconductor layer that is a Group III-V compound having conductivity, as taught by Nakamura, to decrease the resistance of the semiconductor crystal film.

**Conclusion**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to David L. Hogans whose telephone number is (703) 305-3361. The examiner can normally be reached on M-F (7:30-4:30).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr. can be reached on (703) 308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are (703)



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308-7722 for regular communications and (703) 308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-1782.

dh

June 14, 2003

  
CARL WHITEHEAD, JR.  
SUPERVISORY PATENT EXAMINER  
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